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STOCHASTIC STABILIZATION OF PACKET-BASED NETWORKED CONTROL SYSTEMS

Yun-Bo Zhao[1,2], Yu Kang[3], Guo-Ping Liu[1,4] and David Rees[1]

[1]Faculty of Advanced Technology
University of Glamorgan
Pontypridd, CF371DL, United Kingdom
{ gpliu; drees }@glam.ac.uk

[2]Division of Biomedical Engineering
University of Glasgow
Glasgow, G12 8QQ, United Kingdom
yzhao@eng.gla.ac.uk

[3]Department of Automation
University of Science and Technology of China
Hefei 230026, P. R. China

[4]CTGT Center
Harbin Institute of Technology
No. 92, West Da-Zhi Street, Harbin 150001, P. R. China

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Abstract. *A packet-based control approach is proposed for networked control systems (NCSs). This approach takes advantage of the packet-based transmission of the network in NCSs and as a consequence the control law can be designed with explicit compensation for the network-induced delay, data packet dropout and data packet disorder in both forward and backward channels. Under the Markov chain assumption of the network-induced delay (data packet dropout as well), the sufficient and necessary conditions for the stochastic stability and stabilization of the closed-loop system are obtained. A numerical example illustrates the effectiveness of the proposed approach.*
Keywords: Networked control systems, Communication constraints, Markov chain, Packet-based control

1. **Introduction.** Networked Control Systems (NCSs) are such systems where the control loop is closed via some forms of communication network instead of connected directly as assumed in Conventional Control Systems (CCSs) [1]. In NCSs, data is exchanged through a communication network which inevitably introduces communication constraints to the control systems, e.g., network-induced delay, data packet dropout, data packet disorder, data rate constraint, etc. Despite the advantages of the remote and distribute control that NCSs brings, the aforementioned communication constraints in NCSs present a great challenge for conventional control theory [2, 3, 4, 5, 6, 7, 8].

The early work on NCSs has been done mainly from the control theory perspective. Such conventional control theories as time delay system theory [9, 10, 11], stochastic control theory [12, 13, 14, 15], switched system theory [16, 17, 18], have found their applications to NCSs by, typically speaking, modeling the communication network as a negative parameter (mostly a delay parameter) to the system which thus enables a CCS instead of an NCS to be actually considered. These modeling approaches simply ignore the latency of optimizing the system performance by taking advantage of the network characteristics. However, the reality is that the network is not necessarily negative to